5.1 GENERAL

If this equipment does not operate properly, stop work immediately and investigate the cause of the malfunction. Maintenance work must be performed by an experienced person, and electrical work by a trained electrician. Do not permit untrained persons to inspect, clean, or repair this equipment. Use only recommended replacement parts.

WARNING

Be sure that the wall disconnect switch or wall circuit breaker is open before attempting any inspection or work inside of the ESP-50.

5.2 INSPECTION AND CLEANING

Frequent inspection and cleaning of the ESP-50 is recommended for safety and proper operation. Some suggestions for inspecting and cleaning are as follows:

A. Check work cable for secured connection to workpiece.
B. Check safety earth ground at workpiece and at power source chassis.
C. Check heat shield on torch. It should be replaced if damaged.
D. Check the torch electrode and cutting nozzle for wear on a daily basis. Remove spatter or replace if necessary.
E. Make sure cable and hoses are not damaged or kinked.
F. Make sure all plugs, fittings, and ground connections are tight.
G. With all input power disconnected, and wearing proper eye and face protection, blow out the inside of the ESP-50 using low-pressure dry compressed air.
H. Occasionally, bleed all water from the filter beneath the air filter-regulator.

CAUTION

Water or oil occasionally accumulates in compressed air lines. Be sure to direct the first blast of air away from the equipment to avoid damage to the ESP-50.

5.3 PT-35 TORCH CONSUMABLE PARTS

To assemble the consumable parts, refer to Figure 4-1.

WARNING

Make sure power switch on ESP-50 is in OFF position before working on the torch.

A. Thread electrode into torch body, hand tighten.

B. Insert insulator into torch as shown.

C. Place nozzle into the shield.

D. Thread assembly to the torch body and hand tighten. **Always make sure the shield is tight before cutting.**

WARNING

Always replace torch with the proper torch manufactured by ESAB since it alone contains ESAB's patented safety interlock.

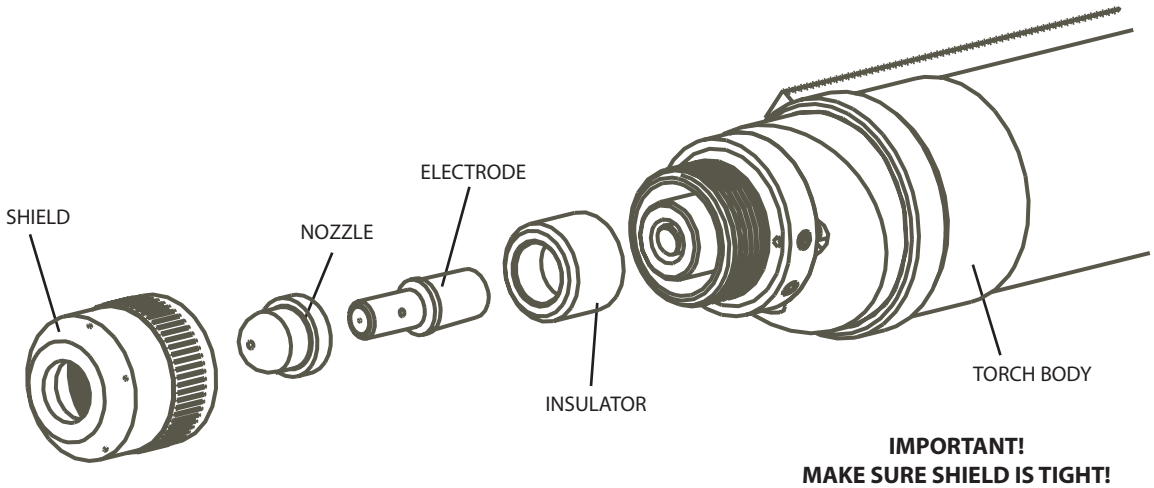


Figure 5-1. Assembly of PT-35 Torch Front End Parts

5.4 IGBT Handling & Replacement

Since IGBT gates are insulated from any other conducting region, care should be taken to prevent static build up, which could possibly damage gate oxides. All IGBT modules are shipped from the factory with conductive foam contacting the gate and emmiter sense pins.

Always ground parts touching gate pins during installation. In general, standard ESD precautlions application to FETs should be followed.

Other handling precautions that should also be observed are as follows:

- **Use grounded work station with grounded floors and grounded wrist straps when handling devices.**
- **Use a 100**Ω resistor in series with the gate when performing curve tracer tests.
- Never install devices into systems with power connected to the system.
- Use soldering irons with grounded tips when soldering to gate terminals.

When mounting IGBT modules on a heatsink, certain precautions should be taken to prevent any damage against a sudden torque. If a sudden torque ("one-sided tightening") is applied at only one mounting terminal the ceramic insulation plate or silicon chip inside the module may get damaged.

The mounting screws are to be fastened in the order shown in Figure 4-3. Also, care must be taken to achieve maximum contact (i.e. minimum contact thermal resistance) for the best heat dissipation.

Application of a thermal pad on the contact surface improves it thermal conductivity. See Replacement Parts section for the required pad.

A torque wrench should be used. Tighten mounting screws to 28 in-lbs (3.2 m-n); wire connecting screws to 19 in-lbs (2.1 m-n). If torque is too heavy, the device can damage like the above "one-sided tightening".

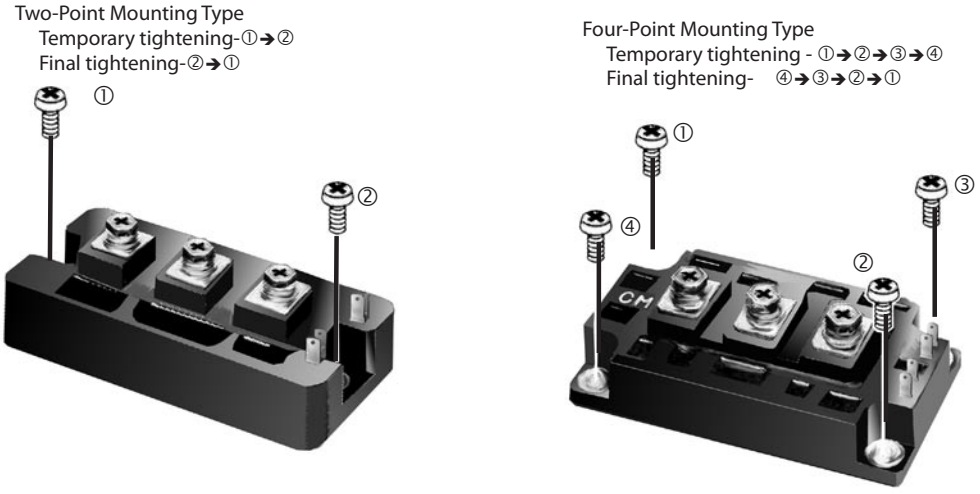


Figure 5-2. Screw Fastening Order

6.1 TROUBLESHOOTING

WARNING

ELECTRIC SHOCK CAN KILL! Be sure that all primary power to the machine has been externally disconnected. Open the line (wall) disconnect switch or circuit breaker before attempting inspection or work inside of the power source.

Check the problem against the symptoms in the following troubleshooting guide. The remedy may be quite simple. If the cause cannot be quickly located, shut off the input power, open up the unit, and perform a simple visual inspection of all the components and wiring. Check for secure terminal connections, loose or burned wiring or components, bulged or leaking capacitors, or any other sign of damage or discoloration.

The cause of control malfunctions can be found by referring to the sequence of operations and electrical schematic diagram (Figure 5-1) and checking the various components. A volt-ohmmeter will be necessary for some of these checks.

NOTE: Before checking voltages in the circuit, disconnect the power from the high frequency generator to avoid damaging your voltmeter.

WARNING

Voltages in plasma cutting equipment are high enough to cause serious injury or possibly death. Be particularly careful around equipment when the covers are removed.

6.2 TROUBLESHOOTING GUIDE

A. Power Light (PL1) does not come on.

1. Visually inspect the machine for any damage.

2. Check if the cooling fan is running. If not, then check the following :

- **a. Check if the machine power cord is plugged to the input power receptacle.**
- **b. Measure the input power at the receptacle. If not present, then check the wall disconnect switch and it's fuses.**
- **c. Check Fuse (F1). If fuse is ok, then check the input switch (S1) for proper operation. Replace if defective.**

3. If above items check OK , the problem is internal. Send unit to an Authorized Repair Station for repair.

- **a. If the cooling fan is running, then measure voltage between pins P2-11 and P2-14 of the control board (should be 115 VAC). If there is no voltage, then replace transformer T2.**
- **b. If the voltage is present, then the pilot light may be burnt out.**

B. Fault light remains on at power-up.

1. Verify start signal is not present. If so, clear start signal, fault should reset.

2. Switch power to OFF, verify consumables are installed correctly.

C. No Air Flow

1. Check air inlet supply. Unit requires 250 CFH (118 l/m) at 60 psig 4.1 bars).

2. Check air hose and connections. Tighten if leaking.

3. Does air flow when "air test" switch is in test position?

   a. If not, check torch consumables, replace if necessary.
   b. If above items check OK , the problem is internal. Take unit to an Authorized Repair Station for repair.

D. The Power light is on, but nothing happens when the torch switch is depressed. Fault light does not activate.

1. Check the following:

a. With the machine power on, depress the torch switch. On the control board the LED 1 should be lit as long as the switch is depressed. If not then check:

i. Turn power off to the machine. Unplug control board. Put an ohmmeter across P5-1 and P5-2 to take resistance reading. Depress torch switch. Meter should read a short. If not, then one of the following is not working properly:

ii. Torch switch or the leads. Unplug the torch switch leads at the machine. Put a meter across the two plug pins. Should read a short when the torch switch is depressed. If not, then either broken switch leads or malfunctioning switch.

b. Check T2 transformer secondary voltages at the plugs P1 and P2. Refer to system schematic. Replace the transformer if the correct secondary voltages are not present.

c. If everything above checks out all right, then the PCB1 Control Board should be replaced.

E. Fault light activates when torch switch is closed.

The Fault circuit is used to monitor conditions necessary for the safe operation of the ESP-50. The fault light will glow amber under the following conditions and operations will come to a complete stop:

1. **High/Low line voltage**. The Fault Light will **rapidly blink on and off** (5 times per second). This indicates that the input voltage is outside the "+" or "-" 15% safe operating range rating.

2. **Over Temperature.** The fault light will be **mostly off but will blink on for 1/10th of a second, every second. This generally indicates that the duty cycle has been exceeded. Allow the power source to cool before returning to operate.**

   a. Thermal switch may be open. It will open if the temperature at the IGBT base reaches 94°C. With the machine power off, check the continuity between P1-1 and P1-2 of the control board. If the switch is OK, then the ohmmeter should read a direct short. If not then it should read open.
   b. If the switch is malfunctioning, replace it. Clean the surface of the heat sink before installing the switch.

3. **Over Current**. The fault light will be on **continuously. This indicates that the input current to the main transformer has exceeded preset limits.**

   a. To check if the output is shorted, remove the heat shield and nozzle from the torch and measure the resistance by putting the ohmmeter lead "+" of the meter to "+" output terminal and Work, "-" lead of the meter to the "-" output torch terminal. Reading should be about 2 K Ohms. Reverse the voltmeter leads, the resistance reading should be less than 1.5 K Ohms.
   b. If the resistance reading is different than above, check the torch and output bridge.

F. Air is On but nothing happens when torch switch is operated.

1. Check the torch. Make sure that the heat shield is very tight.

2. Any one of the following may not be working properly:

a. Check the operation of the Thermal Switch. See D.3.a. above.

b. Check Air Check switch operation. It might be stuck in On position. Pilot arc will not initiate if this switch is in the ON position.
c. Measure voltage across C1 or C2 capacitor. It should be as follows:

approx. 325 VDC for the 208/230 volt unit.
approx. 280 VDC to 325 VDC for the 400 or 460 volt unit

If not, one of following could be malfunctioning:

1). Check the capacitors C1 and C2 for any damage.

2.) Check input bridge/SCR Module (IBR) This can be checked without taking it out of the circuit using an volt/ohmeter. Replace it if found malfunctioning. Follow bridge installation instructions.

3.) Check Inrush current resistor, R10, located on the input bridge heat sink. Replace it if malfunctioning.

d. IGBTs (2 on 230 V, and 1 on the 400 V & 460 V units) may be blown. See IGBT installation procedure. Before replacing IGBTs, make sure to check the zener diodes and pico fuses on the IGBT driver boards.

G. Pilot Arc is on but Main Arc does not transfer.

1. Make sure work clamp is connected to work material.

2. Check the torch. Replace consumables if necessary.

H. Poor Cutting Performance.

1. Check air supply regulator . It should be adjusted to 65 - 75 psig (4.5 - 5.2 bars).

2. The air supplied to the torch should be free of oil and water.

3. Make sure the consumables in the torch are acceptable.

4. Check the output. Use a calibrated current probe capable of measuring 100 amps.

I. Air does not shut off.

1. Check air test, the gas solenoid valve is energized when the switch is in the "on" position.

a. Check voltage to solenoid coil, if present when torch switch is unplugged, replace PCB1.
b. Turn off primary power to the power source. If gas continues to flow, replace the gas solenoid.
c. Turn on primary power and check the status of the Fault light. If the Fault light is on continuously and gas is on continuously, turn off primary power and inspect the torch for proper assembly of the electrode and nozzle. Press firmly on the electrode and verify that it retracts when pressed, and returns forward when released.
d. Reassemble the electrode and nozzle and turn on primary power. After approximately two seconds the gas should come on briefly then go off. If the Fault light comes on continuously and gas remains off, check for defective torch trigger or shorted torch trigger leads. I. Main arc is difficult to start.

J. Main arc is difficult to start.

1. The most common reason is worn or missing consumables. Check and replace if necessary.

2. Input air must be clean and dry.

3. Input air pressure must be between 65 - 75 psig (4.5 - 5.2 bars).

4. Torch connections must be tight.

5. Work cable and clamp must be in good condition and must make a good electrical connection to the material to be cut.

6. If above items check OK , the problem may be internal.

a. Missing or weak pilot arc. Check pilot arc resistors and pilot arc wiring.

Send unit to an Authorized Repair Station for repair.

6.3 REFERENCE VOLTAGE CHECKS

A. Control Board Assembly (PCB1)

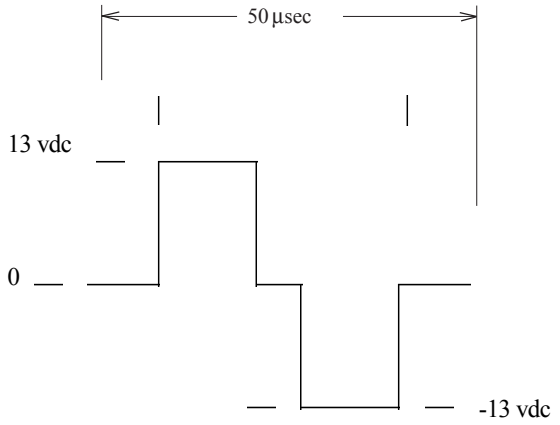
1. **LED's**

LED-1 - Torch Switch
LED-3 - Gas Solenoid Valve

2. Voltage Test Points

Tests are made with power on - no arc.

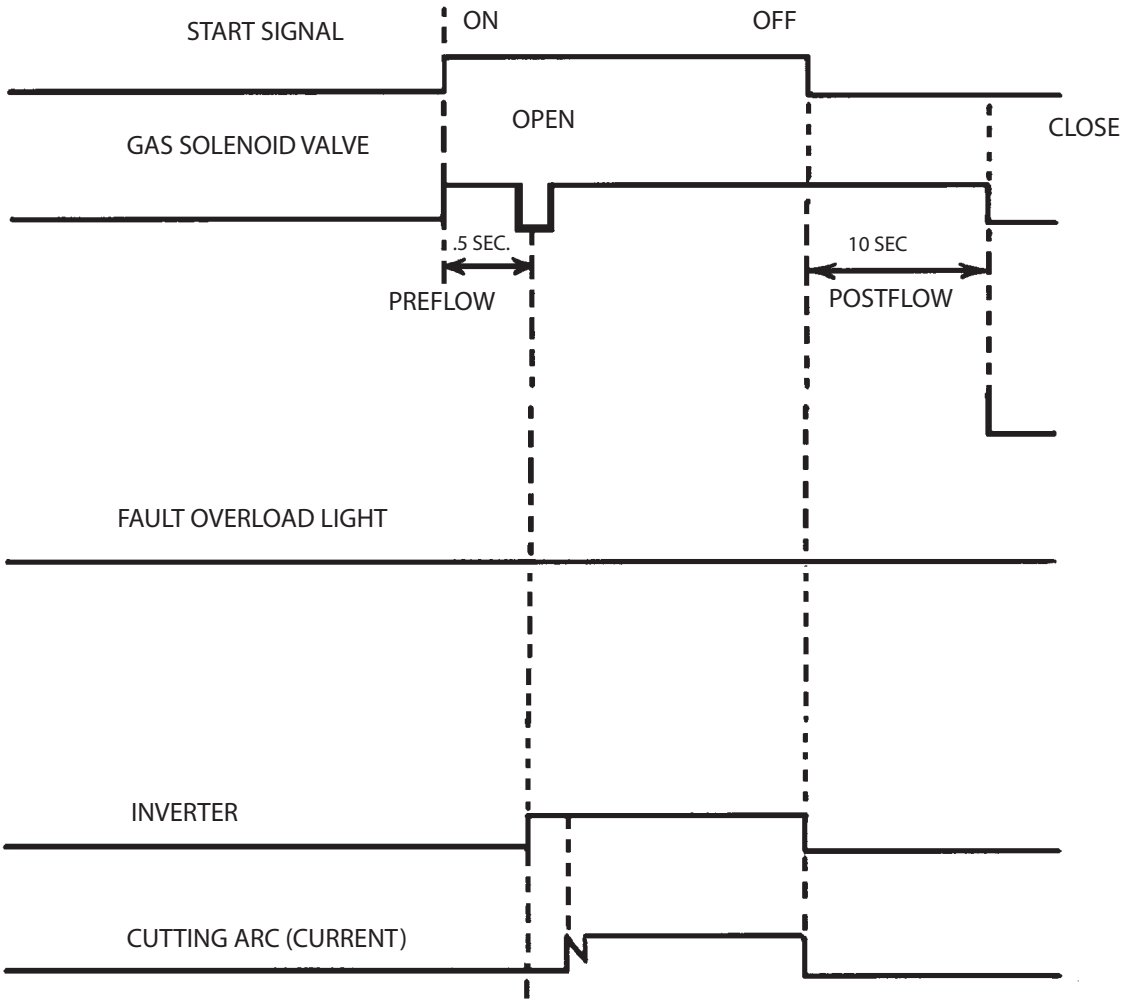
TP-0 - Ground
TP-1 - +15 vdc
TP-2 - +12 vdc
TP-3 - -12 vdc
TP-4 - +5 vdc
TP-9 - IGBT's driving signal - switching frequency = 20 KHz
TP-10 - IGBT's driving signal - switching frequency = 20 KHz



For 208/230 VAC input, the IGBT off time is 3µsec.
For 400/460 VAC input, the IGBT off time is 3µsec.

Figure 6.1 IGBT Gating Signal

6.4 SEQUENCE OF OPERATION



NOTES:

1. When the start signal is turned "on" during postflow period, the postflow and preflow times are canceled.
2. When the amber fault light comes on, cutting operation should be stopped. The postflow time starts from the moment the start signal is removed.

NOTE:
Schematics and Wiring Diagrams on 11″ x 17″
paper are included
inside the back cover of this manual.

7.0 Replacement Parts

7.1 General

Always provide the serial number of the unit on which the parts will be used. The serial number is stamped on the unit nameplate.

7.2 Ordering

To ensure proper operation, it is recommended that only genuine ESAB parts and products be used with this equipment. The use of non-ESAB parts may void your warranty.

Replacement parts may be ordered from your ESAB Distributor.

Be sure to indicate any special shipping instructions when ordering replacement parts.

Refer to the Communications Guide located on the back page of this manual for a list of customer service phone numbers.

Note

Bill of material items that have blank part numbers are provided for customer information only. Hardware items should be available through local sources.

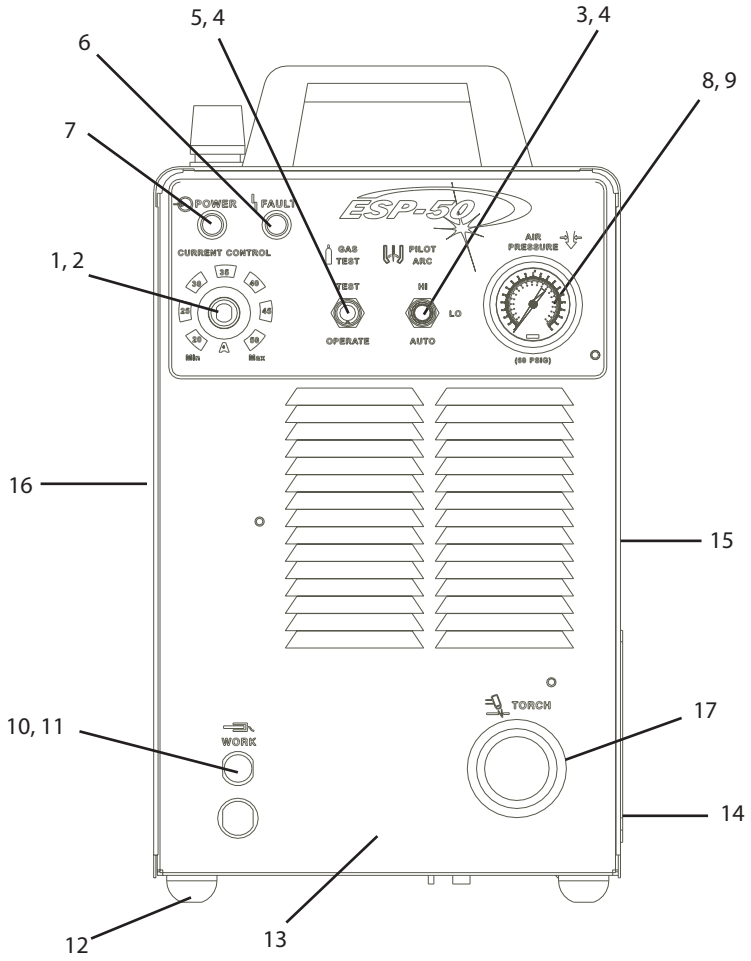


Figure 7-1. ESP-50 Power Source, Front View

Item No.	Qty. Req.	Part No.	Description	Circuit Symbol
1	1	137630611	KNOB	
2	1	0558001176	POT. 10K 3W (NOMEX INSUL. - 676876)	R1
3	1	897W65	SWITCH TOGGLE SPST 3 POS 15 A 125 V	S3
4	2	951474	SWITCH SEAL BLACK	
5	1	634518	SWITCH TOGGLE DPDT 2 POS 15 A 125 V	S2
6	1	951754	LAMP LED YEL 12 V	PL2
7	1	951814	LAMP NEON WHITE	PL1
8	2	0558003378	GAUGE HOUSING	
9	1	21711	GAUGE 1.50 160 PSI WHITE	
10	1	23606172	STRAIN RELIEF	
11	1	680560	WORK CABLE 25 FT. (Not Shown)	
12	4	182W12	FOOT RUBBER	
13	1	0558004314	CHASSIS ESP-50	
14	1	36330YL	DOOR ACCESS YEL (ESAB)	
15	1	954008	LABEL WARNING HI VOLTAGE	
16	2	13734588	LABEL ESAB	
17	1	993426	GROMMET 1.5 X 1.75 X .06	

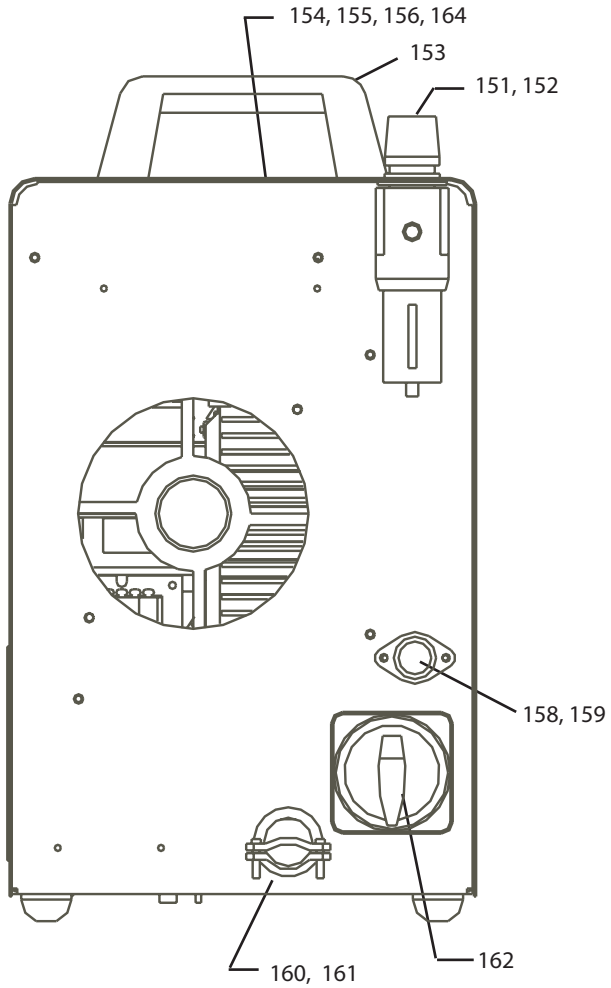


Figure 7-2. ESP-50 Power Source, Rear View

Item No.	Qty. Req.	Part No.	Description	Circuit Symbol
151	1	21710	FILTER REGULATOR	
152	1	10Z30	ADAPTOR B/A-WM x 1/4 NPTM	
153	2	951575	HANDLE	
154	1	36719YL	TOP COVER YEL	
155	1	2091514	LABEL WARNING	
156	1	954290	LABEL WARNING	
157				
158	1	952136	FUSE HOLDER	
159	1	952559	FUSE 3 A FAST ACTING	F1
160	1	97W63	STRAIN RELIEF	
161	1	37573	INPUT POWER CABLE, 6 FT (208/230 V)	
	1	0558001181	INPUT POWER CABLE, 10 FT (400CE/460 V)	
162	1	36107	SWITCH POWER 600V 63A	S1

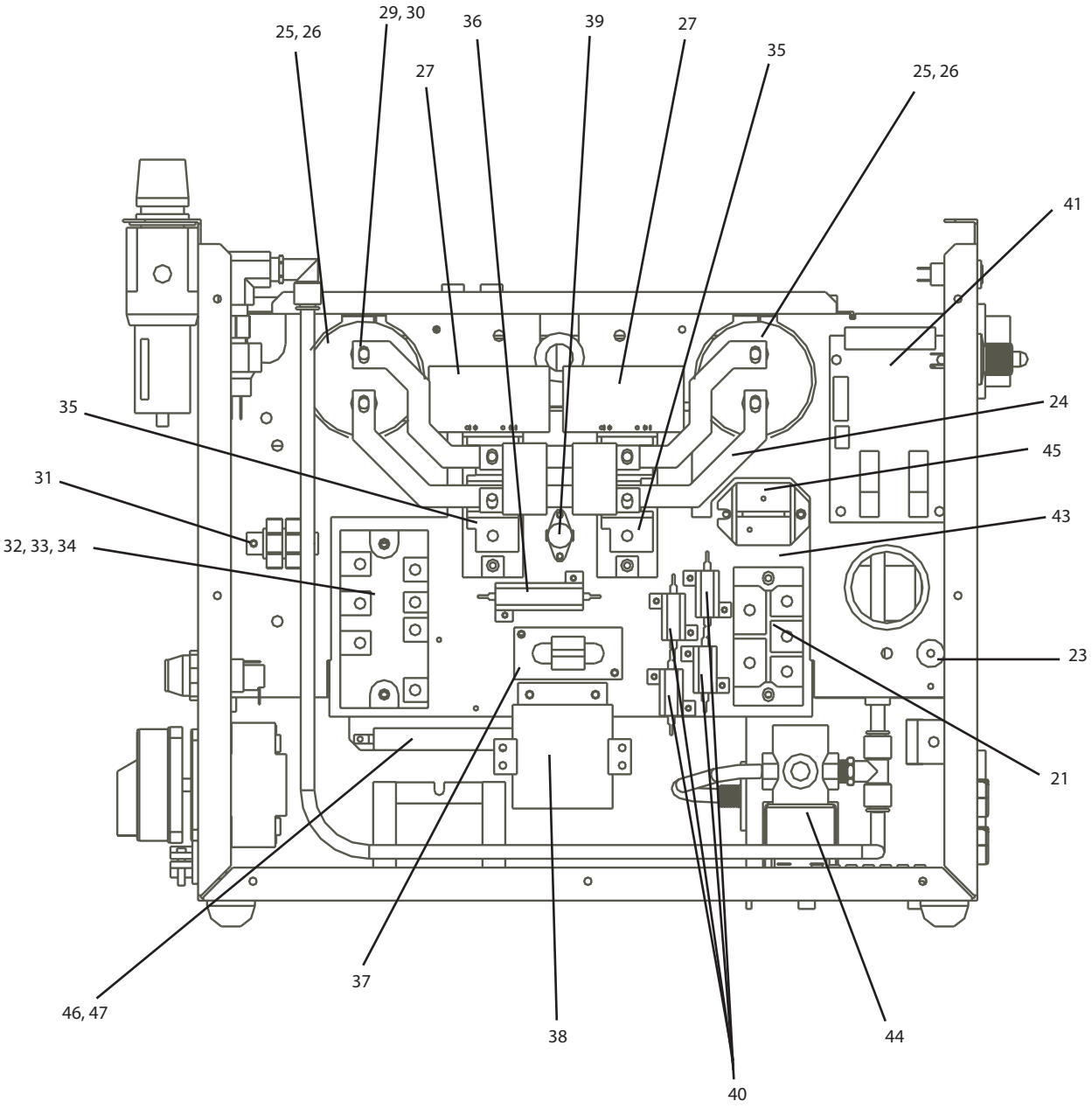


Figure 7-3. ESP-50 Power Source, Left Side View (208/230)

Item No.	Qty. Req.	Part No.	Description	Circuit Symbol
21	1	952150	BRIDGE 60ADC 100NS 600 V (includes PAD - 951192)	D1
22	1	952002	CORE SATURABLE (Not shown - see wiring)	L3
23	1	952208	STANDOFF INSULATING NYLON	TB3
24	1	36731	BUSBAR NEG	
25	2	952237	CAPACITOR 1800 µf 450VDC	C1, 2
26	2	994674	GROMMET STRIP	
27	2	0558001177	PCB ASS'Y MOSFET IGBT DRIVER BOARD	PCB2, 3
28				
29	1	36730	BUSBAR POS	
30	1	951028	CAPACITOR 1µf 630VDC (Not shown - see wiring)	C3
31	1	950487	TERM BLOCK 2 POS	TB5
32	1	952235	MODULE INPUT BRIDGE/SCR (includes PAD - 952280)	IBR
33	1	2062282	CAPACITOR .22µf 1KV (See wiring)	C19
34	3	951321	METAL OXIDE VARISTOR 275 V (See wiring)	MOV1, 2, 3
35	2	951205	IGBT 600 V 100 A (includes PAD - 951190)	Q1, 2
36	1	17750010	RESISTOR 50 W 10 OHM (PAD - 951194)	R7
37	1	32958	CURRENT TRANSFORMER ASS'Y	T4
38	1	952255	CAPACITOR 40 µf 400 VDC	C4
39	1	950711	THERMAL SWITCH 194°F	TS1
40	4	17721020	RESISTOR 24 W 20 OHMS (PAD 951193)	R3, 4, 5, 6
41	1	0558038258	PILOT ARC CONTROL PCB	PCB4
42	2	951940	CAPACITOR 1µf 630W VDC	C15, 16
43	1	952558	HEATSINK	
44	1	0558004447	SOLENOID VALVE 1/4NPT NC 24 VAC	SOL1
45	1	0558002436	DIODE SINGLE FAST RECOV	D2
46	1	17250010	RESISTOR WW FIXED 50W 10 OHM	R10
47	2	99512068	RESISTOR BRACKET	
48	1	0558003105	PRESSURE SWITCH	PS1

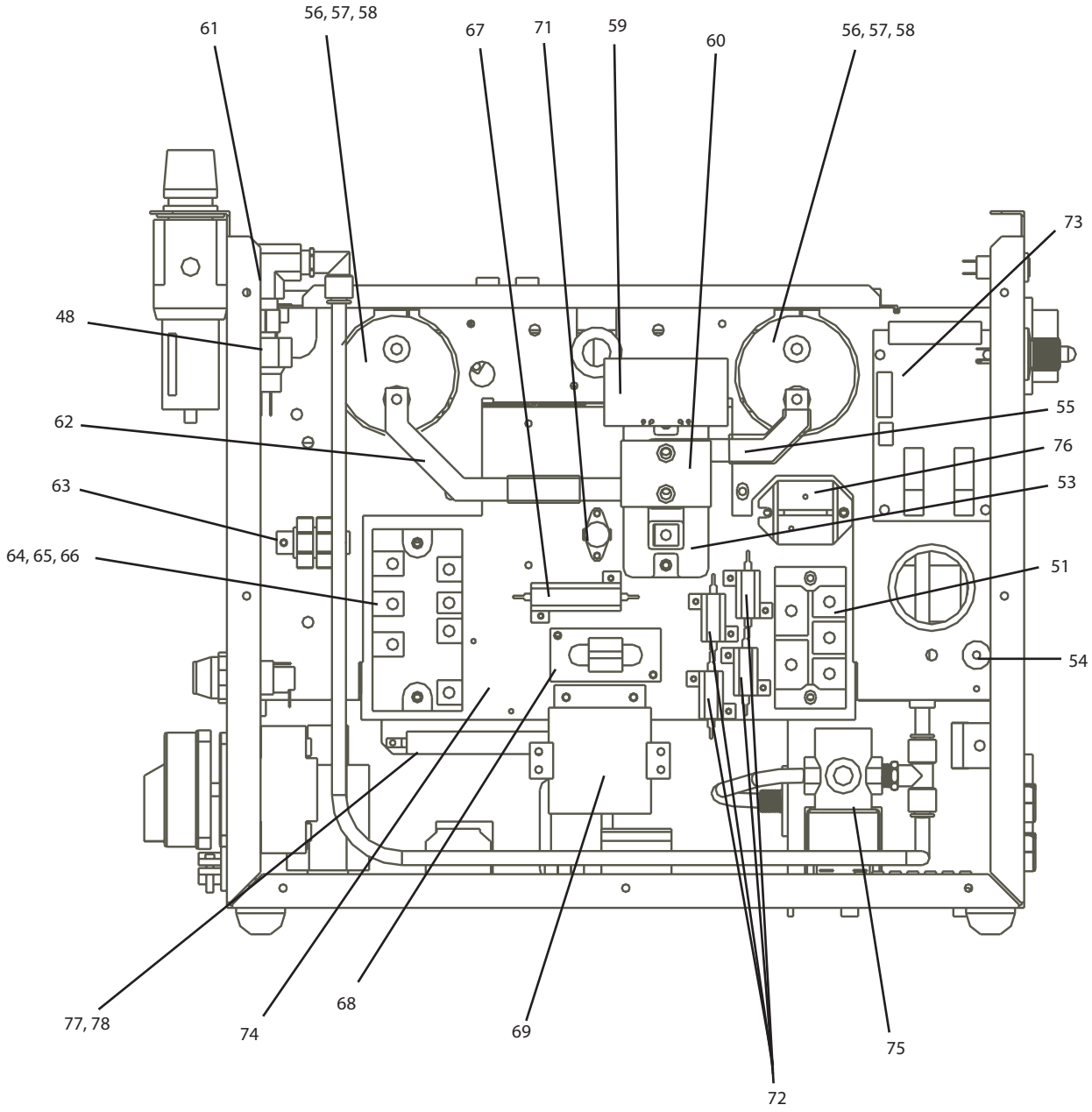


Figure 7-4. ESP-50 Power Source, Left Side View (400CE/460)

Item No.	Qty. Req.	Part No.	Description	Circuit Symbol
51	1	952150	BRIDGE 60 ADC 100NS 600 V (includes PAD - 951192)	D1
52	1	952002	CORE SATURABLE (Not shown - see wiring)	L3
53	1	951800	MODULE DUAL IGBT 150 A, 1200 V	
			(includes PAD - 951191)	Q1
54	1	952208	STANDOFF INSULATING NYLON	TB3
55	1	36732	BUSBAR POS	
56	2	952237	CAPACITOR 1800µf 450 VDC (400CE/460 V)	C1, 2
	2	952562	CAPACITOR 1800µf 500 VDC (575 V)	C1, 2
57	2	994674	GROMMET STRIP	
58	2	951028	CAPACITOR 1µf 630 VDC (See wiring)	C3, 15
59	1	0558001178	PCB ASS'Y IGBT DRIVER BOARD	PCB2
60	1	951964	CAPACITOR 2µf 800 VDC (400CE/460V)	C16
61	1	36822	HOSE ASS'Y B/A x 1/4 NPT RUB	
62	1	36733	BUSBAR NEG	
63	1	950487	TERM BLOCK 2 POS	TB5
64	1	952235	MODULE INPUT BRIDGE/SCR	
			(includes PAD - 952280)	IBR
65	1	2062282	CAPACITOR .22µf 1KV	C19
66	3	950591	METAL OXIDE VARISTOR 510 V (400CE/460 V)	MOV1, 2, 3
67	2	17750010	RESISTOR 50W 10 OHM (PAD - 951194)	R7
68	1	32958	CURRENT TRANSFORMER ASS'Y	T4
69	1	952255	CAPACITOR 40µf 400 VDC (400CE/460 V)	C4
70	1	058004394	INDUCTOR, PILOT ARC	L4
71	1	950711	THERMAL SWITCH 194°F	TS1
72	4	17721020	RESISTOR 25W 20 OHMS (PAD - 951193)	R3, 4, 5, 6
73	1	0558038258	PILOT ARC CONTROL PCB	PCB4
74	1	952558	HEATSINK	
75	1	950249	SOLENOID VALVE 1/4 NPT 165 PSI 24 VAC	SOL1
76	1	0558002436	DIODE SINGLE FAST RECOV	D2
77	1	17250010	RESISTOR WW FIXED 50W 10 OHM	R10
78	2	99512068	RESISTOR BRACKET	

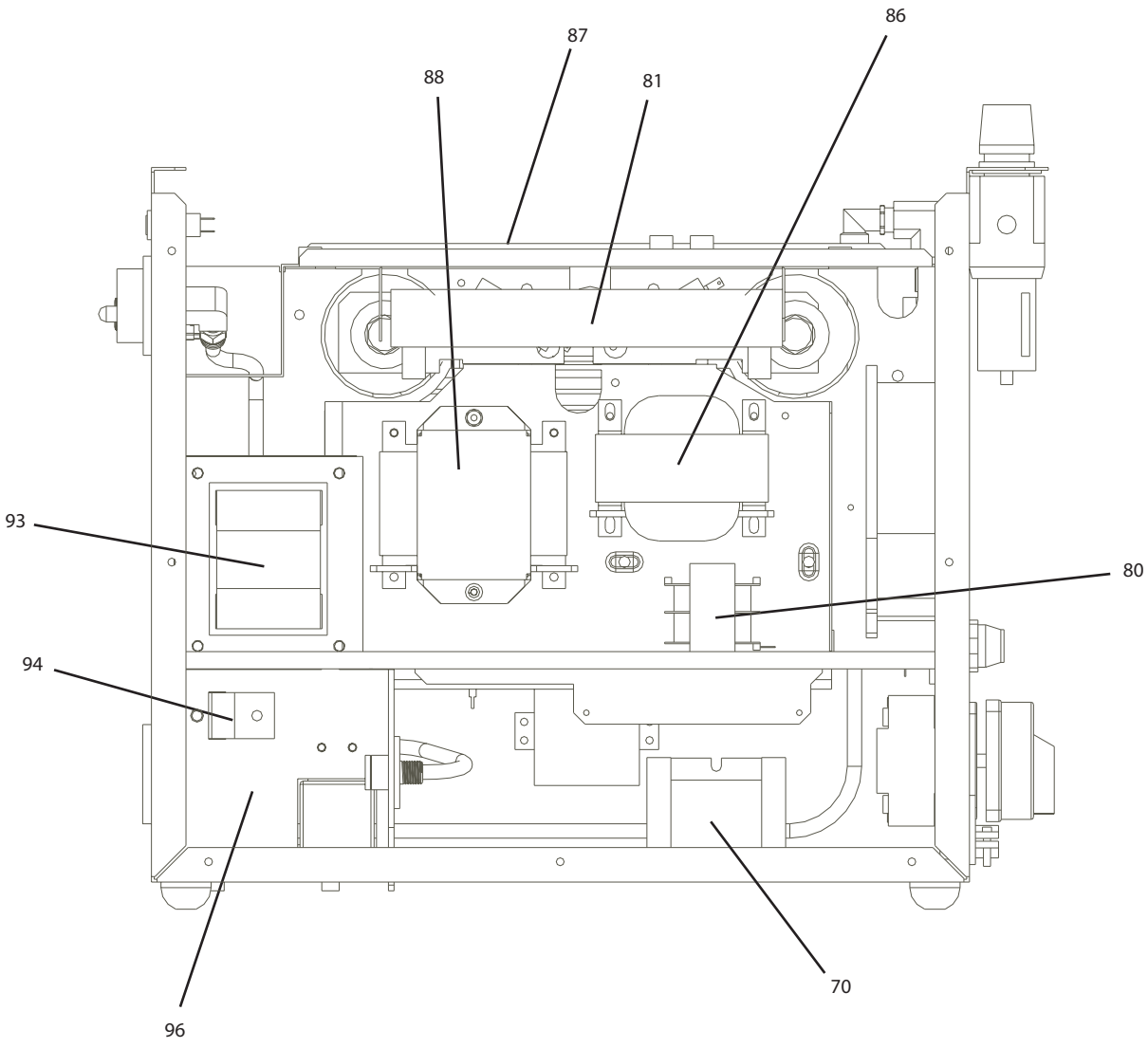


Figure 7-5. ESP-50 Power Source, Right Side View (208/230)

Item No.	Qty. Req.	Part No.	Description	Circuit Symbol
80	1	35940	CONTROL TRANSFORMER ASS'Y	T2
81	2	17300008	RESISTOR 300W 8 OHM	R11,12
82	1	0558004394	INDUCTOR, PILOT ARC	L4
83				
84				
85	1	23604891	LABEL WARNING HI VOLTAGE RED	
86	1	952232	INDUCTOR PFC	L2
87	1	0558038261	CONTROL BOARD ASS'Y	PCB1
88	1	0558004395	MAIN TRANSFORMER ASS'Y	T1
89	2	951469	CAPACITOR .022µf 250 VAC (See Wiring)	C17, 18
90				
91	2	951515	CAPACITOR .047µf 660 VAC	C21,C23
92				
93	1	952233	INDUCTOR OUTPUT	L1
94	1	36721	BUSBAR OUTPUT	
95				
96	1	36717	BRACKET OUTPUT	
97				
98				
99				
100				
101				
102	2	672348	CAPACITOR .01µf 1KV (See wiring)	C11, 12
103	1	952204	CAPACITOR .01µf 250 VAC (See wiring)	C9
104				
105				

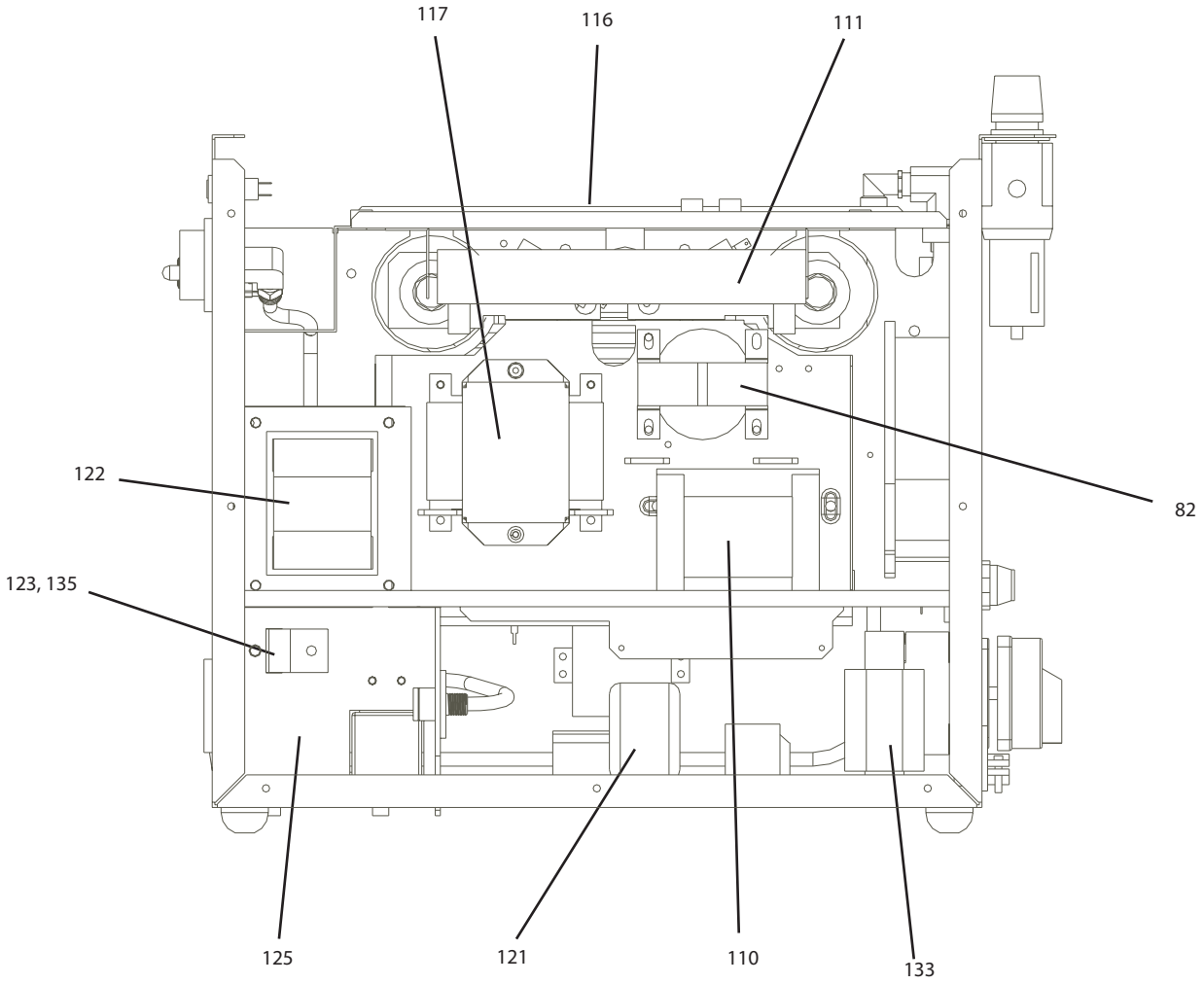


Figure 7-6. ESP-50 Power Source, Right Side View (400CE/460)

Item No.	Qty. Req.	Part No.	Description	Circuit Symbol
110	1	32914	CONTROL TRANSFORMER ASS'Y	T2
111	1	17300008	RESISTOR 300W 8 OHM	R11,12
112				
113				
114				
115	1	23604891	LABEL WARNING HI VOLTAGE RED	
116	1	0558038261	CONTROL BOARD ASS'Y	PCB1
117	1	0558004395	MAIN TRANSFORMER ASS'Y (400CE/460 V)	T1
118	2	951469	CAPACITOR .022µf 250 VAC (See wiring)	C17, 18
119				
120	1	951515	CAPACITOR .047µf 660 VAC	C23
121	1	0455803881	EMF FILTER BOARD	PCB5
122	1	952233	INDUCTOR OUTPUT	L1
123	1	36721	BUSBAR OUTPUT	
124				
125	1	36717	BRACKET OUTPUT KYDEX	
126				
127				
128				
129				
130	1	950487	TERM BLOCK 2 POS 20 A	TB1
131	2	672348	CAPACITOR .01µf 1KV (See wiring)	C11, 12
132	1	952204	CAPACITOR .01µf 250 VAC (See wiring)	C9
133	1	952213	REACTOR 3PH LINE 12 A	L2
134				
135	1	951314	CAPACITOR .022µf 1KV (See wiring)	C20

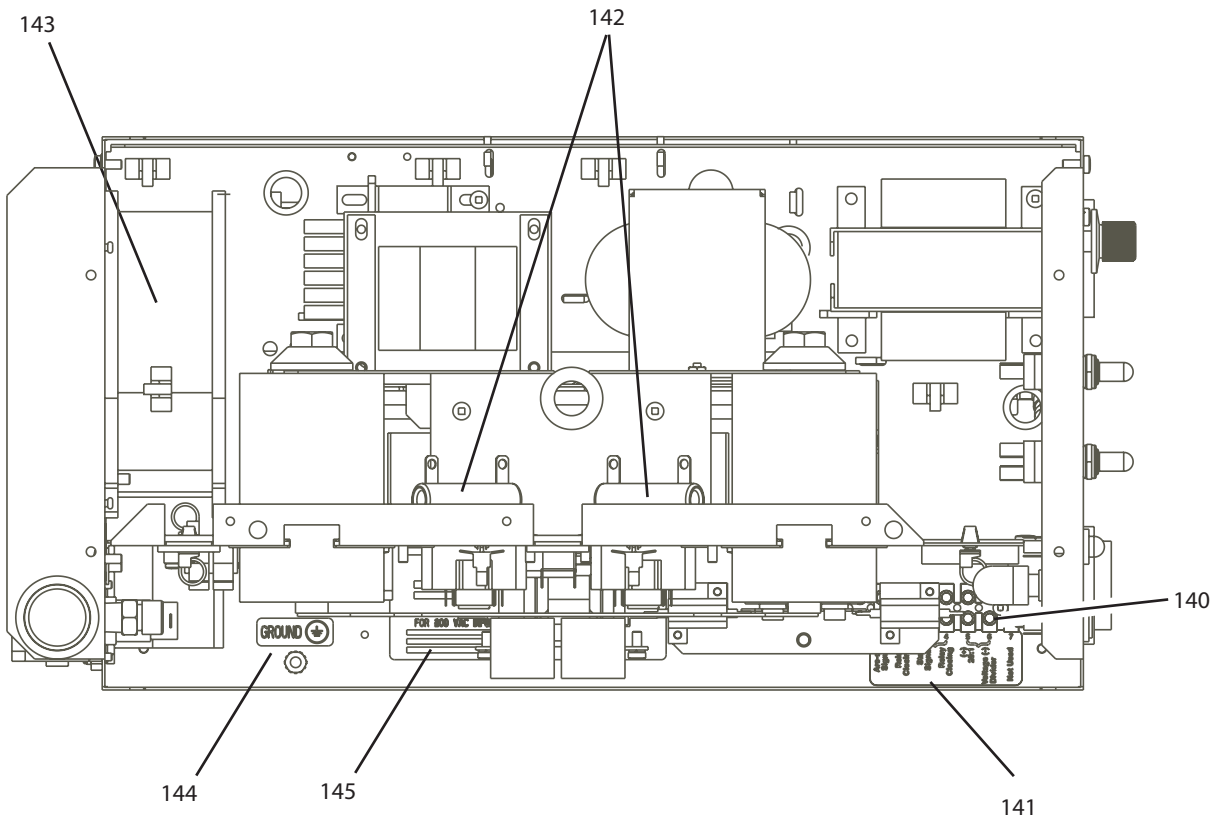


Figure 7-7. ESP-50 (208/230V) Power Source, Top View with PCB1 and Shelf Removed

Item No.	Qty. Req.	Part No.	Description	Circuit Symbol
140	1	954673	LABEL CNC INTERFACE	
141	1	952026	TERM BLOCK 7 POS 25 A	TB4
142	2	17240310	RESISTOR 10 K 25 W	R2, 15
143	1	951182	FAN AC AXIAL	M1
144	1	2091558	LABEL GROUND BLACK	
145	1	954700	LABEL INPUT (208/230 V)	
	1	954681	LABEL INPUT (400CE/460 V)	

NOTES

REVISION HISTORY

1. Original release of this manual: 02/2004.

2. 04/2004 Revision - added Pierce Height to cut data charts.

3. 01/2005 Revision - Section 2 - Chgd electrode p/n from: 0558004355 to: 0558005200 in cut data charts. Added p/n's 0558004973 & 0558004974 for ESP-50 208/230 V PT-35 packages without rack. |Updated torch specifications figure 2-1 & 2-2 drawing. Updated spare parts kits with new p/n 0558005210, consumable value pack p/n 0558005203, consumable set p/n 0558005201 & consumable set p/n 0558005202. Section 4 - Updated figure 4-2 to show new electrode drawing. Created schematic pack (with new p/n's 0558004710 & 0558004711) for back cover insert.

4. Revision - 05/2005 - added Air Line Filter Regulator p/n 0558005394 note in Replacement Parts section per CN #053013.

5. Revision - 01/2006 - Removed filter regulator, item 151, p/n 0558005394 note, in replacement parts section per D. Smith.

6. Revision - 10/2007 - Updated info with 380/400 designations & updated disclaimer.

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